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SUBJECT Volman Generators and Hardening Machines for
High Frequency Induction and Dielectric Heating

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REPORT NO. 50X1-HUM

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**THIS IS UNEVALUATED INFORMATION FOR THE RESEARCH
USE OF TRAINED INTELLIGENCE ANALYSTS**50X1-HUM a pamphlet entitled "High-Frequency Heat for Rapid Heating of Metal" prepared by Dr Stivin of Volman Co, United Machine Tool Works National Corporation in Rychnov U Jablonce, Czechoslovakia.

50X1-HUM

The pamphlet contains 16 pages and discusses the application of high-frequency heating in industry, including the high-frequency induction heating of metals and the high-frequency dielectric heating of non-metallic materials. There are 17 illustrations showing parts of the machines and generators. The pamphlet also lists the advantages of high-frequency hardening and the outstanding features of Volman hardening machines, as well as the manufactured types of Volman-Stivin high-frequency generators. The pamphlet was produced in 1947 and is in English.

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HIGH-FREQUENCY HEAT FOR RAPID HEATING OF METAL

**VOLMAN-
STIVIN**

- HIGH-FREQUENCY GENERATORS
- HARDENING AUTOMATICS AND MACHINES
- MACHINES FOR HOT-FORMING
- EQUIPMENT FOR DIELECTRIC HEATING
- DESIGN OF EQUIPMENTS FOR SPECIAL PURPOSES OF THE HIGH-FREQUENCY TECHNIQUE
- HIGH-FREQUENCY HARDENING SHOP

UNITED MACHINE TOOL WORKS

NATIONAL CORPORATION PRAHA - WORKS RYCHNOV U JABLONCE n./M. - CZECHOSLOVAKIA

Application of the High-Frequency Heating in Industry

The possibility only of surface heating or accurately regulated local heating of material within a few seconds, enabled by induction heating with high-frequency current, means a revolutionary turn in the heat-treatment of materials. In principle it is possible to apply this new method especially for the following operations:

HIGH-FREQUENCY INDUCTION HEATING OF METALS.

At this operation the surface of the material is heated by direct passage of high-frequency eddy currents. These currents are generated by action of the so called inductor through which passes the high-frequency current from the generator. This inductor is usually a water-cooled work coil of one or several windings having a suitable shape and surrounding accurately just those spots of the part which are to be heated. Therefore the surface of the part is heated at first and the further penetrating of heat into the core proceeds automatically. This method enables a quite new, better, cleaner and more efficient technologic operations particularly at the

surface hardening of steel
forming and forging of metals
annealing
soldering and brazing.
welding and melting of metals etc.

Suitable steels for high-frequency hardening were developed by the steel works POLDINA HUT /formerly POLDIHÜTTE/ and are supplied under the mark "POLDI EVF". For highly stressed parts as gears, shafts, crankshafts of cars and aeroplanes are used the chromium - vanadium alloy steel "POLDI EVF 310" or the chromium steel "POLDI EVF 105". For not so severely stressed parts are employed cheaper alloy carbon steels like "POLDI EVF 55" or "POLDI EVF 50".

In cases where an absolute uniformity of the structure is not required also common carbon steels with more than 0.45 per cent carbon can be used if they are suitable for hardening treatment.

HIGH-FREQUENCY DIELECTRIC HEATING OF NON METALLIC MATERIALS.

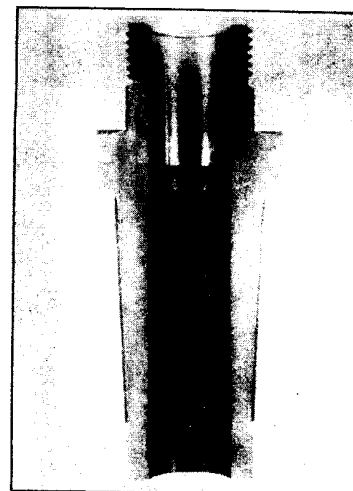
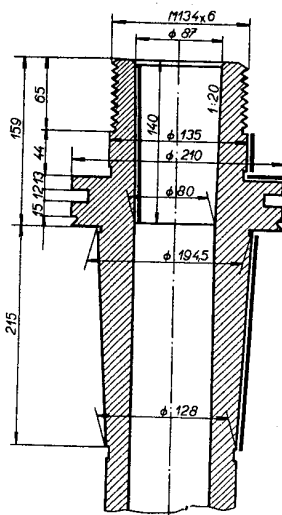
The parts is put into the high-frequency field which is made by a set of electrodes usually fed with high-frequency current from the generator having in the rule a frequency of 5 - 15 Mc. The part is heated by dielectric losses generated in all the section of the piece so that only the core of the piece is heated.

High-frequency generators of such an especially high frequency can be employed for dielectric heating of semi-conductors at the

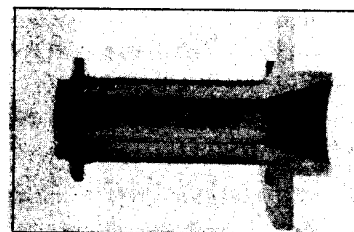
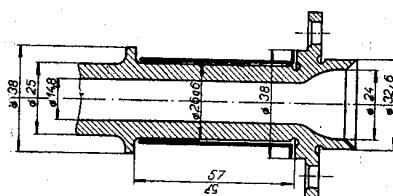
hardening of synthetic materials /plastics/
drying and pasting of wood
sterilization of food etc.

The advantage of the dielectric heating is that all the part is heated at once. From this reason it is possible to heat the part much more rapidly than at the usual method when the heat is lead through the surface which can be easily overheated. Furthermore at the dielectric heating there is no crust on the surface avoiding the vapours to escape from the interior of the part. By this fact a rapid heating is enabled.

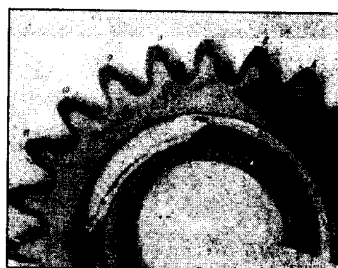
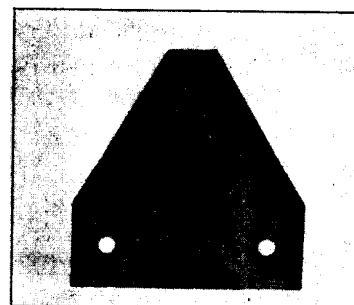
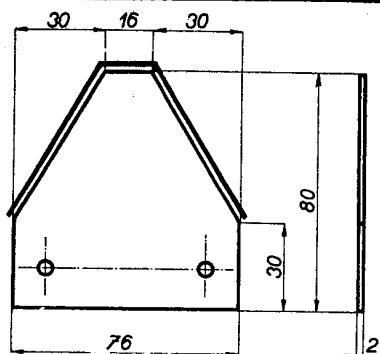
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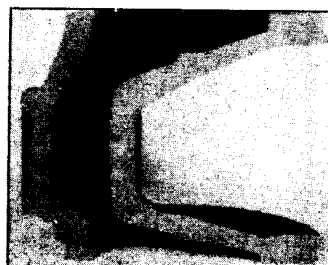
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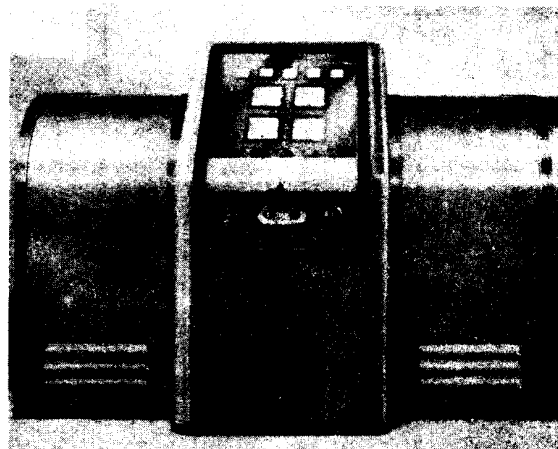
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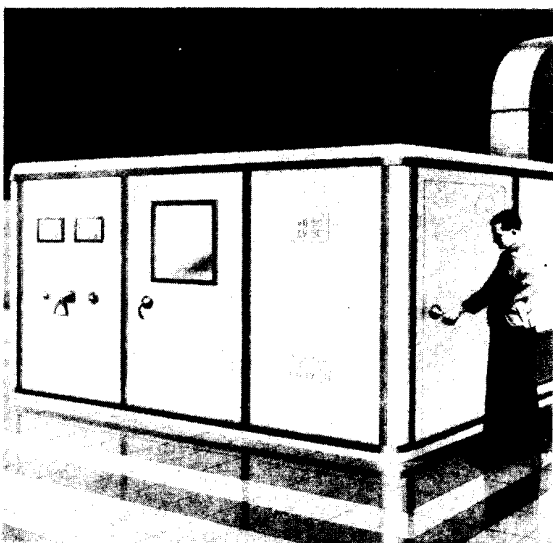
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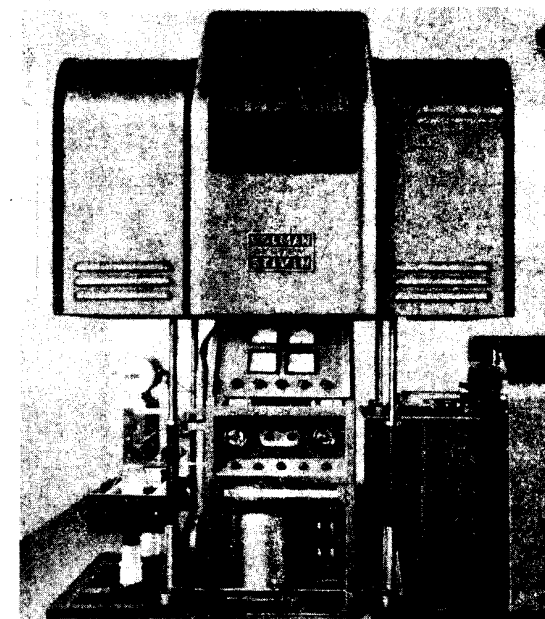
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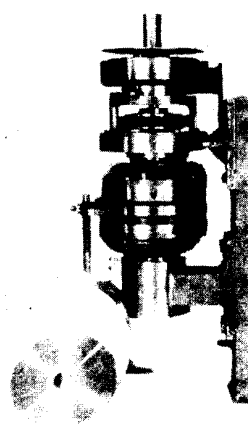
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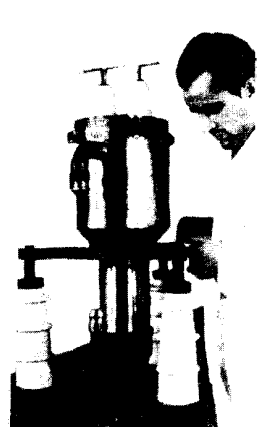
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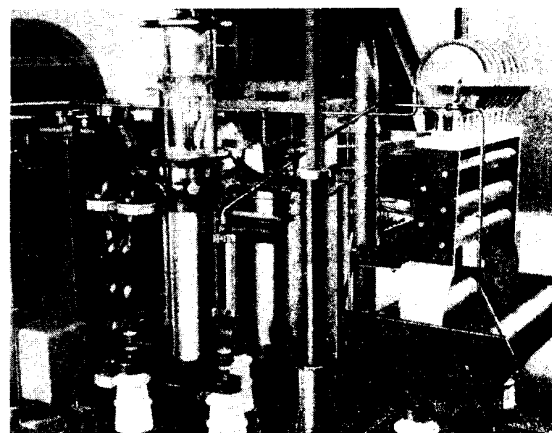
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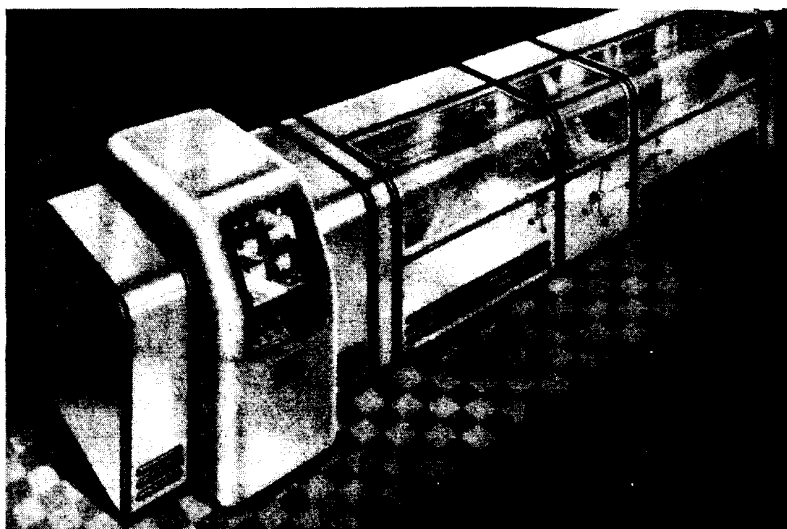
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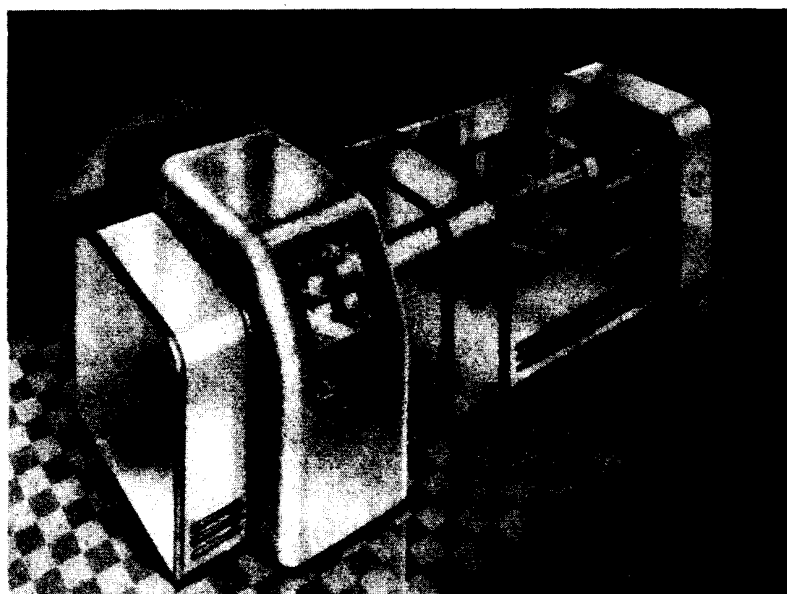
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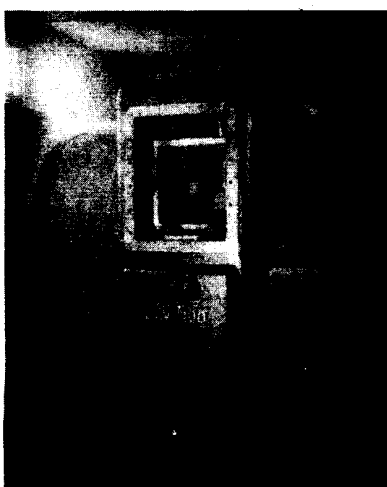
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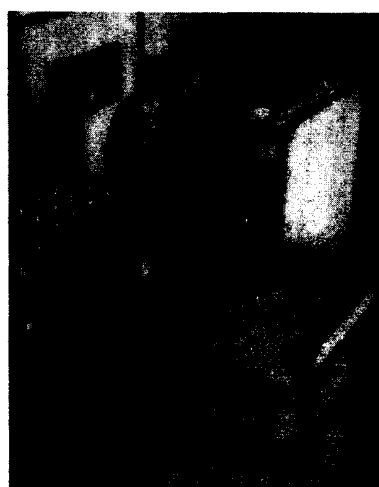
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DESCRIPTION FOR THE ILLUSTRATIONS 1-17

- 1/ LATHE SPINDLE. Operation I: Inner taper
 High-frequency output power 150 kW
 Heating rate 25 s
Operation II: Flange with the cylindric part
 High-frequency output power 105 kW
 Heating rate 12 s
Operation III: Inner taper
 High-frequency output power 120 kW
 Heating rate 18 s
- 2/ LEADING BEARING OF CAMSHAFT FOR AEROPLANE MOTOR.
 High-frequency output power 115 kW
 Heating rate 4.5 s
- 3/ CUTTER FOR MOWING - MACHINE.
 High-frequency output power 18 kW
 Heating rate 0.9 s
- 4/ HARDENING OF GEARS. Modul 3 - 23 teeth - Width 20 mm - interior diam. 75 mm
 High-frequency output power 80 kW
 Heating rate 1.8 s
- 5/ HARDENING OF CRANKSHAFT-PINS. Diam. of the pin 90 mm, length 75 mm
 High-frequency output power 70 kW
 Heating rate 28 s
- 6/ MICROSCOPICAL PHOTO of the passage between the induction-hardened surface and the not heat-treated core.
- 7/ Original high-frequency generator of 200 kW output power, built in the year 1940 - still in service.
- 8/ New model of generator of 200 kW output power, built already in series as the TYPE GV 200.
- 9/ Rectifier, switch attachment and cooling equipment for the generator TYPE GV 200.
- 10/ Generator TYPE GV 50 with lifted hood.
- 11/ Control equipment for measuring of the high-frequency energy.
- 12/ Metallic valve 200 kW.
- 13/ The interior of the generator TYPE GV 200.
- 14/ Generator with hardening machine TYPE V 1 for hardening of camshafts.
- 15/ Generator with the hardening machine TYPE R 2 for hardening of rotating parts in horizontal position.
- 16/ Automatic machine TYPE R 3 for mass hardening of small pieces.
- 17/ Vertical hardening machine TYPE R 1 for hardening of gears etc.

Advantages and Outstanding Features of the High-Frequency Hardening

- 1/ Considerable output - up to some thousands of hardened parts per hour.
- 2/ Ease of control even when operated by unskilled workers.
- 3/ Elimination of surface cracking due to grinding.
- 4/ No distortions of the hardened parts so that in the rule neither grinding nor other finishing operations are necessary.
- 5/ The hardened surface layer forms a compact unit with the not hardened core.
- 6/ Clean surface of the hardened parts /no scales/.
- 7/ No expensive alloy steels are necessary because also with common carbon steels excellent results can be attained. Steels especially suitable for induction hardening are produced already in mass by the steel works POLDINA HUT /formerly POLDIHÜTTE/ under the mark "POLDI EVF".
- 8/ Relatively small floor space /about 10 per cent/ and consumption of electric current /about 3 - 5 per cent/ in comparison with a normal hardening shop of the same output.
- 9/ The hardening operation can be located in the production line as any other operation.
- 10/ Cleanliness and safety of the plant from the hygienic point of view.
- 11/ Lower production costs than at any other surface hardening method.

Manufactured Types of High-Frequency Generators VOLMAN-STIVÍN

TYPE	FREQUENCY	O U T P U T				
		Starting load. The heating rate is not longer than 5 sec. The relation of the heating rate to the time of the following interruption is not higher than 1:2		Continuous load		Max. output power in calories per hour
		Max. high-freq. output power on the binding posts of the generator in kW	15 minute's input power maximum from the net in kW	Max. continuous high-frequency output power on the binding posts of the generator in kW	Input power from the net	
GU 5	5 - 15 MC			5	12	4.300
GU 20	5 - 15 MC			20	45	17.200
GV 50	500 kC	50	38	30	70	25.800
GV 100	500 kC	100	75	70	150	60.000
GV 200	500 kC	200	150	125	270	107.500

OUTSTANDING FEATURES OF OUR MACHINES

SAFETY: Safety switch does not allow the high-tension to start as long as the cabinet is open.

EASE OF CONTROL: Push button control - and the operation follows automatically.

CLEANLINESS OF OPERATION: The proper hardening operation proceeds under a hood, the hardening machines are provided with vapour exhaustors.

PRECISION OF WORK: The depth of the hardening layer once pre-set is maintained automatically also at oscillations and changes of the net-tension.

PROTECTION OF CIRCUITS: All circuits are protected against overload and short circuits. The high-frequency circuit is protected by fuses against overload.

COMPLETE SHIELDING: Protection is provided in order to avoid wireless jamming.

METALLIC VALVES: Our industrial tubes have no fragile exterior parts and can be treated as any other electric apparatus.

LONG LIFE: The heating of valves is controlled in a special way so that the filament serves many thousands of work hours. All mechanical parts are of special resistance.

EASY REMOVAL OF DEFECTS: In case of troubles is the current switched off automatically and the sort of defect is announced by a transparent inscription. The cabinet may be easily lifted by motoric power, thus making the interior easily accessible.

We supply - according to the character of the production - the following types of hardening machines to be connected to a high-frequency generator:

Type	Description of the hardening machines	Maximal dimensions of the:			Output pieces/hour
		hardened surface		part to be gripped	
		Hardening of the:			
		exterior	bore		
R 1	Vertical semi-automatic machine of simple design for hardening of flat cylindrical parts like gears etc. The feed attachment and the movable safety hood are controlled by a foot lever. The speed change of the hardened part is effected by change wheels. The hardening operation is controlled automatically.	diam.200 length 90		diam.200 length 90	150-200
R 2	Automatic machine for hardening of rotating parts in horizontal position. The control of the machine is eliminated to the putting in and taking out of the hardened part from the automatic feed attachment. Gear box giving 3 rotating speeds of the hardened part is controlled by a hand lever. The hardening operation proceeds automatically. Also the exterior variable influences /e.g. changes of tension/ are compensated automatically.	diam.200 length 100		diam.250 length 600	200-300
R 3	Vertical automatic machine for mass hardening of small pieces like nuts, screws, pins etc. The possibility of employing an automatic magazine makes the machine independent on the operator. The heating rate and the number of the hardened pieces are controlled by the mechanism of the machine. The hardened parts are collected in a work basket automatically.	diam. 80 length 40	diam. 70 length 40	diam. 80 length 60	1000-2000

R 4	Automatic vertical machine for hardening of flat cylindrical parts on the outer surface as well as in the bore. The control of the machine is eliminated to the putting in and taking out of the hardened parts from the automatic feed attachment. The safety hood is controlled automatically. The exterior influences are compensated automatically.	diam.250 length 120	diam.200 length 120	diam.250 length 120	200-350
K 1	Special machine for hardening of crankshafts in vertical position. The duplication system enables the putting in and taking out of the shafts during the hardening operation. The shafts are hardened successively so that in one position are hardened the connecting-rod shafts and in the other the bearing shafts. In case of the same diameter but a different length of the hardened spots the inductors are reset successively and automatically to the right length. The hardening operation follows automatically.	diam.100 length 120		diam.250 length 1200	5 - 10
V 1	Special semi-automatic machine for hardening of camshafts in horizontal position. The spots to be treated are hardened successively. The machine is provided with several inductors the suitable of which is set right by a special selector. The setting of the camshafts into the right position and the clamping of the inductor jaws follows hydraulically. The hardening operation proceeds automatically.	diam. 60 length 60		diam.200 length 1200	10 - 30
P 1	Semi-automatic machine for feed hardening. It is designed for hardening of long-shaped parts of different profiles. The change of feed speed and of rotations of the hardened part can be done to a large extent by change wheels. The machine is equipped with a rapid return-feed attachment. The hardening operation is controlled automatically.	diam.220 length 1200	diam.280 length 600	diam.300 length 1200	up to 150
<p>The outputs per hour stated above are given under the condition that the machines are fed by a high-frequency generator of a capacity responding to the hardened surface, i.e. on average about 0.5 - 1.0 kW/sq.cm of the heated surface. For surface hardening of thick-wall and simple-shaped parts a lower specific capacity may be used /0.2 - 0.5 kW/sq.cm/, thus prolonging the heating rate and reducing the output per hour of the machine.</p> <p>For hardening of special parts which are not suitable for the heat-treatment on the above mentioned models we supply machines of special design</p>					